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Evaluating the Strategies for Implementation of Software Solutions among Construction Professionals in Lagos State, Nigeria

Kareem Mukaila Oluseyi[1], Akanni Prince Oluleye[2], Ayotomide James Obasa[3]

[1,2]Department of Building, School of Environmental Technology,
[3]Quantity Surveying Department, Research Student, School of Environmental Technology,
[1,2,3]Federal University of Technology, Akure, Nigeria

ABSTRACT

As the need for infrastructure increases, the adoption of efficient construction management methods becomes essential. The construction sector in Lagos State, Nigeria, faces several challenges that hinder project efficiency, particularly regarding the limited adoption of construction management software solutions like Building Information Modeling (BIM). Assessing strategies for implementing construction management software solutions among professionals in Lagos State, Nigeria, is crucial due to the diverse challenges confronting the industry. This study evaluates the strategies for implementing construction management software solutions among construction professionals in Lagos State, Nigeria. A quantitative methodology was employed, gathering data through questionnaires distributed to construction professionals including engineers, architects, builders, and quantity surveyors. The study reveals that despite the potential benefits of software solutions like Building Information Modeling (BIM), barriers such as insufficient training, resistance to change, and lack of funding hinder widespread adoption. Additionally, the research identifies key strategies for addressing challenges, including improving technical expertise, integrating data analytics, and enhancing workforce health initiatives. The findings offer valuable insights into optimizing project management practices and improving the efficiency of the construction sector in Lagos State.

KEYWORDS: *Management Software, BIM, Project Management, Software Adoption, Construction Professionals*

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1. INTRODUCTION

The construction industry is a critical driver of economic growth and infrastructure development, particularly in rapidly urbanizing regions like Lagos State, Nigeria. As one of the fastest-growing megacities globally, Lagos faces increasing demands for infrastructure, necessitating efficient construction management methods. Construction management software solutions have emerged as indispensable tools for optimizing project processes, enhancing productivity, and improving overall project outcomes. The role of construction managers in Lagos State is pivotal in addressing the complexities of construction projects, emphasizing the need for a thorough evaluation of how software solutions can address unique industry challenges (Osuizugbo *et al*., 2020; Olanrewaju *et al*., 2020). Integrating advanced practices and fostering a supportive organizational culture are key factors for the successful implementation of these tools, leading to improved project performance and outcomes. Despite the global recognition of construction management software like Building Information Modeling (BIM) for its potential to enhance project outcomes, its adoption in Lagos State remains limited. Challenges such as traditional contracting methods, resistance to change, and insufficient training hinder the effective application of these technologies (Hamma-Adama & Kouider, 2020). Persistent reliance on manual processes and outdated cost management methods further restricts their potential (Latiffi *et al*., 2014). While the influence of High-Performance Work Practices (HPWP) on project performance is

acknowledged (Alonge, 2019), gaps remain in understanding the role of software solutions in overcoming critical barriers, such as health and safety challenges and environmental management issues Software solutions designed for scheduling, budgeting, resource allocation, and communication can significantly enhance project workflows and outcomes (Jibril & Shaban, 2021). This study evaluates strategies for implementing construction management software solutions among professionals in Lagos State, Nigeria. By examining the factors that influence adoption and identifying effective strategies to address industry challenges, this research aims to contribute to the optimization of construction management practices. The findings will provide insights into how construction professionals can leverage technology to boost productivity, improve safety, and achieve sustainable project outcomes, ultimately supporting the broader development goals of Lagos State.

2. Research Methodology

2.1. Theory and Equation

The sample size for the study was calculated using Yamane's (1967) formula:

$$n = \frac{N}{1 + N(e)^2} \quad (1)$$

where n is the required sample size, N is the population size, and e is the margin of error. The study determined a minimum sample size of 370 participants.

2.2. Materials and Methods

A quantitative research methodology was employed to gather data in Lagos State, Nigeria. Questionnaires were distributed to licensed engineers, architects, builders, and quantity surveyors to capture demographic details such as profession, years of experience, and educational background. The survey, designed to evaluate strategies for software solution implementation among construction professionals, used a Likert-type scale ranging from 1 (Very Low) to 5 (Very High). The study targeted registered professionals in the construction industry, with 320 questionnaires distributed using the census technique. Of these, 291 responses (79% response rate) were returned and deemed suitable for analysis, surpassing typical response rates in management research. Data collection lasted two months, with surveys administered by hand.

Descriptive statistics (mean scores and frequency distributions) were presented in tables and charts. Factor analysis and mean item scoring were employed as primary statistical techniques, with reliability assessed using Cronbach's alpha test. All analyses were conducted using SPSS version 27, a statistical software for the social sciences.

3. Results and Discussion

3.1. Respondent Information

A summary of the demographic and occupational traits of a sample population of 291 professionals is provided by the data (Table 1). A sizable majority, 74.2% (216 professionals), have degrees at the HND/PGD/B.Sc./B-Tech level, suggesting a highly educated workforce. Of those with a master's degree (M.Sc.), 15.5% (45 professionals) have one, and 3.1% (9 professionals) have a PhD. 21 professionals, or just 7.2%, possess an Ordinary National Diploma (OND). The workforce appears to be well-established, as many responders (51.5%, or 150 professionals) had between 11 and 15 years of experience. Furthermore, 84 professionals, or 28.9%, have 16–20 years of experience, whereas 39 professionals, or 13.4%, have 6–10 years. Interestingly, no responders with more than 20 years of experience are included. At 37.1% (108 professionals), builders make up the largest category in terms of professional roles. They are followed by quantity surveyors (25.8%, or 75 professionals), architects, and civil engineers (13.4% each). Professionals in project and construction management comprise 10.3% (30 professionals). There is a notable male predominance in the gender distribution (79.4%, or 231 professionals). A mature workforce is suggested by the age distribution, which shows that 73.2% (213 professionals) are between the ages of 36 and 45. The significant majority, 90.7% (264 professionals), are married, which could have an impact on organizational policy and work-life balance. In conclusion, the evidence points to a highly educated, experienced workforce that is primarily male and concentrated in medium-sized organizations. These traits may impact future workforce development programs and organizational dynamics.

Table 1: Background Information of Respondents

Variable	Classification	Frequency	Percent
Academic Qualification	OND	21	7.2
	HND/PGD/ B.SC/B-Tech	216	74.2
	M.Sc.	45	15.5
	PhD	9	3.1
	Total	**291**	**100.0**

Years of working experience	1-5 years	18	6.2
	6-10 years	39	13.4
	11-15 years	150	51.5
	16-20 years	84	28.9
	20 years and above	0	0
	Total	**291**	**100.0**
Type of practice	Architect	39	13.4
	Builder	108	37.1
	Civil Engineer	39	13.4
	Project/Construction Mgt.	30	10.3
	Quantity Surveyor	75	25.8
	Total	**291**	**100.0**
Size of your organization	1-5	24	8.2
	6-20	21	7.2
	21- 50	198	68.1
	51-100	42	14.4
	100 and above	6	2.1
	Total	**291**	**95.7**
Gender	Male	231	79.4
	Female	60	20.6
	Total	**291**	**100.0**
Age	25 -35yrs	33	11.3
	36-45yrs	213	73.2
	46-and above	45	15.5
	Total	**291**	**100.0**
Marital Status	Not married	27	9.3
	Married	264	90.7
	Total	**291**	**100.0**

3.2. Challenges of Integrating Software Solutions in Construction Project Management Processes

The Table 2 identifies and ranks challenges in integrating software solutions into construction project management processes based on their mean scores and standard deviations. The top challenges include inadequate funding by the client (mean = 3.62, SD = 3.097) and structural failure during construction (mean = 3.59, SD = 3.091), highlighting critical concerns about financial resources and structural integrity, with varied experiences among respondents. Competent team availability (mean = 3.48, SD = 2.368) and poor technical knowledge of contractors (mean = 3.39, SD = 0.620) emphasize the need for skilled personnel and contractor expertise. Process-related issues like lack of quality assurance (mean = 3.37) and slow decision-making processes (mean = 3.36) reflect moderate concerns about ensuring high-quality outcomes and efficiency. Design and execution challenges, such as architectural drawings (mean = 3.35) and inadequate site supervision (mean = 3.34), alongside low-skill workers (mean = 3.30) and poor construction materials (mean = 3.29), impact project execution. Lower-ranked challenges, including unrealistic project costs, improper planning, and communication issues, remain significant despite lower means (~3.26). The varying standard deviations indicate diverse experiences, providing insights for prioritizing strategies to overcome these obstacles effectively.

Table 2: Challenges of Integrating Software Solutions in Construction Project Management Processes

Challenges of Integrating Software Solutions	Mean	Std. Deviation	Rank
Inadequate funding by the client	3.62	3.097	1
Structural failure during construction	3.59	3.091	2
Competent team availability	3.48	2.368	3
Poor technical knowledge of contractors	3.39	0.620	4
Lack of quality assurance	3.37	0.709	5
Slow decision-making processes	3.36	0.722	6
Architectural drawings	3.35	0.780	7
Inadequate site supervision	3.34	0.786	8
Low-skill workers	3.30	0.803	9

Poor quality of construction materials	3.29	0.787	10
Unrealistic project cost	3.28	0.655	11
Construction program document	3.28	0.823	12
Failure to engage qualified professionals	3.27	0.741	13
Improper planning at the pre-construction phase	3.26	0.804	14
Aesthetics of completed work	3.25	0.788	15
Implementation of safety management system	3.23	0.845	16
Work breakdown structure	3.23	0.845	17
Improper scheduling of project activities	3.23	0.667	18
Contractor bankruptcy/business failure	3.23	0.741	19
Regular maintenance of project equipment	3.21	0.898	20
Availability of funds as planned	3.20	0.826	21
Communication and coordination between parties	3.16	0.847	22
Adequacy of raw materials and equipment	3.15	0.805	23
Clear and timely inspections	3.13	0.972	24

3.3. Factor Analysis for Challenges of Integrating Software Solutions in Construction Project Management Processes

Factor analysis was conducted to identify variables that measure similar underlying dimensions. Before performing principal component analysis, the suitability of the data was evaluated. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was applied to determine whether the data distribution was appropriate for factor analysis. According to Field (2009), a KMO index of 0.50 or higher and a significant Bartlett's test of sphericity ($p < 0.05$) are considered sufficient for factor analysis. As shown in Table 3, the KMO index for this study is 0.760, exceeding the minimum threshold, and Bartlett's test of sphericity is significant ($p = 0.000$). These results confirm that the data is suitable for factor analysis.

Table 3: KMO and Bartlett's Test for Challenges of Integrating Software Solutions

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.690
Bartlett's Test of Sphericity	Approx. Chi-Square	4044.061
	Df	276
	Sig.	0.000

3.4. Challenges of Integrating Software Solutions in Construction Project Management Processes

Table 4 reveals that 8 components with eigenvalues greater than 1.0 were extracted using the factor loading of 0.30 as the cut-off point which was recommended by Pallant (2005). The TVE by each component extracted is as follows; component 1 (18.37%), component 2 (15.24%), component 3 (10.77%), component 4 (9.06%), component 5 (7.64%), component 6 (6.28%), component 7 (5.29%), and component 8 (4.55%). The principal component analysis revealed that the extracted components accounted for approximately 77% of the total cumulative variance among the factors. In behavioral studies, it is uncommon to divide variables into entirely independent groups. As such, using orthogonal rotation, such as varimax, may result in the loss of valuable information when correlations exist among factors. In contrast, oblique rotation is theoretically better suited for such cases, as it provides a more accurate representation of interrelated factors. Oblimin, an oblique rotation method, was chosen over varimax because, in social sciences, correlations among factors are typically expected. However, when no correlations are present, both oblique and orthogonal rotation methods yield nearly identical results (Costello & Osborne, 2005).

Table 4: Total Variance Explained for Challenges of Integrating Software Solutions

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	4.410	18.374	18.374	4.410	18.374	18.374	3.208
2	3.657	15.235	33.610	3.657	15.235	33.610	3.120
3	2.586	10.773	44.383	2.586	10.773	44.383	2.458
4	2.175	9.062	53.445	2.175	9.062	53.445	2.994

5	1.833	7.637	61.082	1.833	7.637	61.082	2.512
6	1.507	6.278	67.360	1.507	6.278	67.360	2.293
7	1.271	5.294	72.654	1.271	5.294	72.654	1.424
8	1.093	4.554	77.208	1.093	4.554	77.208	2.343
9	0.918	3.826	81.033				
10	0.688	2.868	83.901				
11	0.639	2.664	86.565				
12	0.509	2.119	88.684				
13	0.408	1.700	90.384				
14	0.381	1.587	91.971				
15	0.324	1.349	93.320				
16	0.290	1.208	94.528				
17	0.266	1.109	95.638				
18	0.219	0.910	96.548				
19	0.188	0.784	97.332				
20	0.173	0.722	98.054				
21	0.144	0.601	98.655				
22	0.119	0.495	99.150				
23	0.104	0.435	99.585				
24	0.100	0.415	100.000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Table 5: Pattern Matrix (PM) for Challenges in Integrating Software Solutions

Factor	Component							
	1	2	3	4	5	6	7	8
Implementation of safety management system	0.850							
Regular maintenance of project equipment	0.787							
Clear and timely inspections	0.713							
Competent team availability	0.705							
Slow decision-making processes		0.914						
Inadequate site supervision		0.864						
Unrealistic project cost		0.854						
Construction program document			-0.900					
Architectural drawings			-0.786					
Work breakdown structure			-0.784					
Low-skill workers				0.939				
Lack of quality assurance				0.887				

Table 6: Pattern Matrix (PM) for Challenges in Integrating Software Solutions Contd.

Factor	Component							
	1	2	3	4	5	6	7	8
Poor quality of construction materials				0.784				
Poor technical knowledge of contractors				0.518				
Failure to engage qualified professionals					0.787			
Improper scheduling of project activities					0.772			
Contractor bankruptcy/business failure					0.743			
Improper planning at the pre-construction phase					0.645			
Aesthetics of completed work						0.875		
Availability of funds as planned						0.788		
Inadequate funding by the client						0.454		
Structural failure during construction							0.868	
Communication and coordination between parties								0.888
Adequacy of raw materials and equipment								0.842

Extraction Method: Principal Component Analysis.

3.5. Reporting the Eight Clustered Factors for Challenges of Integrating Software Solutions

The pattern matrix expresses the coefficients for the linear combination of variables measured. Negative factor loadings indicated that the variables are to be interpreted in the opposite direction. However, this does not exclude them from the construct (Burns and Grove 2010). Each factor was named by using a name that reflects all the variables. And where there was difficulty in picking a suitable name, the variable(s) that has the highest factor loadings among all the variables that loaded onto a factor was used in naming that factor. The eight-factor groupings are reported as follows.

(i) A total of four (4) variables loaded onto factor 1 as shown in table 4 which indicates that these variables are identified as the topmost factors for the Challenges of Integrating Software Solutions. This factor loads 'Implementation of safety management system', Regular maintenance of project equipment', 'Clear and timely inspections', and 'Competent team availability'. Therefore, they are collectively called 'Implementation of safety management system' and account for 18.37 percent of the variance.

(ii) A total of three (3) variables loaded onto Factor 2 as shown in table 4. This factor loads 'Slow decision-making processes', 'Inadequate site supervision', and 'Unrealistic project cost. They were collectively named 'Slow decision-making processes" and account for 15.24 percent of the variance.

(iii) Three (3) variables were loaded onto Factor 3 as shown in table 4. This factor loads 'Construction program document', 'Architectural drawings', and 'Work breakdown structure'. Therefore, they were collectively called 'Construction program documents" and account for 10.77 percent of the variance.

(iv) Four (4) variables were loaded onto Factor 4 as shown in table 4. This factor loads 'Low-skill workers', 'Lack of quality assurance', 'Poor quality of construction materials', and 'Poor technical knowledge of contractors'. Therefore, they were collectively called 'Low-skill workers' and account for 9.06 percent of the variance.

(v) Four (4) variables were loaded onto Factor 5 as shown in table 4. This factor loads 'Failure to engage qualified professionals', Improper scheduling of project activities', 'Contractor bankruptcy/business failure' and 'Improper planning at the pre-construction phase'. Therefore, they were collectively called 'Failure to engage qualified professionals and account for 7.64 percent of the variance.

(vi) Three (3) variables were loaded onto Factor 6 as shown in table 4. This factor loads 'Aesthetics of completed work', Availability of funds as planned', and 'Inadequate funding by the client'. Therefore, they were collectively called 'Aesthetics of completed work' and account for 6.28 percent of the variance.

(vii) One (1) variable was loaded onto Factor 7 as shown in table . This factor loads 'Structural failure during construction'. Therefore, they were collectively called 'Structural failure during construction' and account for 5.29 percent of the variance.

(viii) Two (2) variables were loaded onto Factor 7 as shown in table . This factor loads 'Communication and coordination between parties' and 'Adequacy of raw materials and equipment'. Therefore, they were collectively called 'Communication and coordination between parties and account for 4.55 percent of the variance.

Table 7: Reduced Components for Challenges of Integrating Software Solutions

Components	Variables	Factor loadings
Implementation of safety management system	Implementation of safety management system	0.850
	Regular maintenance of project equipment	0.787
	Clear and timely inspections	0.713
	Competent team availability	0.705
Slow decision-making processes	Slow decision-making processes	0.914
	Inadequate site supervision	0.864
	Unrealistic project cost	0.854
Construction program document	Construction program document	-0.900
	Architectural drawings	-0.786
	Work breakdown structure	-0.784
Low-skill workers	Low-skill workers	0.939
	Lack of quality assurance	0.887
	Poor quality of construction materials	0.784
	Poor technical knowledge of contractors	0.518

Failure to engage qualified professionals	Failure to engage qualified professionals	0.787
	Improper scheduling of project activities	0.772
	Contractor bankruptcy/business failure	0.743
	Improper planning at the pre-construction phase	0.645
Aesthetics of completed work	Aesthetics of completed work	0.875
	Availability of funds as planned	0.788
	Inadequate funding by the client	0.454
Structural failure during construction	Structural failure during construction	0.868
Communication and coordination between parties	Communication and coordination between parties	0.888
	Adequacy of raw materials and equipment	0.842

3.6. The Strategies for Needs and Challenges of Software Solutions in Construction Project Management Processes

The table analyzes strategies for addressing challenges related to software solutions in the construction sector, ranking them by their mean scores. These scores reflect respondents' agreement on the importance of each strategy, while standard deviations indicate variability in responses. The top-ranked strategy is Data Analytics in Marketing, with a mean score of 3.91 and a high standard deviation of 5.063. This highlights strong recognition of the role data analytics can play in enhancing marketing efforts. However, the significant variability suggests differing levels of familiarity and experience with analytics tools among organizations. Family Planning Services ranks second with a mean score of 3.60 and a standard deviation of 4.090, emphasizing the growing importance of integrating employee well-being and work-life balance into construction project management.

Work-Related Musculoskeletal Disorders (WMSDs) Impact ranks third with a mean of 3.51 and a lower standard deviation of 0.692, signalling widespread consensus on addressing health challenges caused by physical strain in construction work. Strategies such as Health and Well-being (mean = 3.41), Customer Relationship and Market Penetration (mean = 3.39), and Physical Activity Promotion (mean = 3.38) show moderate recognition, with varying perceptions reflecting different organizational priorities. Mid-range strategies like Technology Adoption and Innovation (mean = 3.35) and Disaster Management and Resilience (mean = 3.34) are acknowledged but demonstrate variability in implementation. Lower-ranked strategies, including Sustainability and Environmental Impact (mean = 3.21) and Artificial Intelligence in Construction (mean = 3.18), are less recognized, though their importance may vary by project or organization. Overall, the analysis highlights diverse perspectives on these strategies, offering insights into how organizations can better leverage software solutions to enhance project outcomes and address industry challenges effectively.

Table 8: The Strategies for Needs and Challenges of Software Solutions

The Strategies for Needs and Challenges of Software Solutions	Mean	Std. Deviation	Rank
Data Analytics in Marketing	3.91	5.063	1
Family Planning Services	3.60	4.090	2
Work-Related Musculoskeletal Disorders (WMSDs) Impact	3.51	0.692	3
Health and Well-being	3.41	0.514	4
Customer Relationship and Market Penetration	3.39	0.530	5
Physical Activity Promotion	3.38	0.754	6
Technology Adoption and Innovation	3.35	0.576	7
Disaster Management and Resilience	3.34	0.536	8
Quality and Reliability	3.33	0.588	9
Environmental Economic Practices	3.32	0.652	10
Operational Efficiency.	3.29	0.610	11
Facilities Management and Infrastructure	3.28	0.513	12
Sustainability and Environmental Impact	3.21	0.556	13
Green Housing Imperatives	3.18	0.748	14
Competitive Intelligence for SMEs	3.18	0.675	15
Artificial Intelligence in Construction	3.18	0.675	16

3.7. Challenges of Integrating Software Solutions in Construction Project Management Processes

The integration of software solutions in construction project management is accompanied by several challenges that significantly influence project outcomes. Chief among these is inadequate client funding, highlighting the essential role of financial resources in the successful adoption and implementation of software tools. Savio and Dewan, (2023) note that limited funding can hinder the acquisition of essential software and training, ultimately reducing project efficiency and effectiveness. Additionally, Hamada (2023) suggests that differing views on funding adequacy are influenced significantly by project-specific dynamics.

Structural failures during construction pose a significant challenge, highlighting the importance of preserving structural integrity, which can be compromised by inadequate or ineffective software application. The complexity of construction projects, coupled with the varying effectiveness of software in addressing structural risks, intensifies this problem. Vincent et al. (2020) argue that advanced technologies, such as Building Information Modeling (BIM), are crucial in enhancing structural planning and monitoring, which in turn helps mitigate the risk of failures. Another prominent obstacle is the availability of skilled teams, which is crucial for effectively implementing and managing software solutions. Barghoth et al. (2020) suggest that responses consistently recognize the significance of team competence, as evidenced by the limited variation in perceptions among respondents. Furthermore, Wang et al. (2013) highlight that inadequate technical expertise among contractors underscores the widespread awareness of the need for specialized knowledge to fully leverage the potential of software tools. This underscores the importance of workforce training and capacity building to support software integration in construction projects.

Challenges such as inadequate quality assurance processes and slow decision-making also hinder efficiency in project management. Escalona et al. (2022) suggest that the variability in responses indicates these issues are shaped by the specific circumstances of each project. Additionally, Liu et al. (2021) note that inadequate site supervision and a lack of skilled labour exacerbate the challenges of software adoption, resulting in inconsistencies in execution and project quality. In conclusion, the adoption of software solutions in construction project management is obstructed by various challenges, with insufficient funding and structural failures being especially notable.

From the Factor analysis carried out on the Challenges of Integrating Software Solutions in Construction Project Management Processes, eight factors emerged and are discussed as follows,

3.7.1. Cluster 1 – Implementation of safety management system

Integrating software solutions in construction project management encounters various challenges, as highlighted by key variables such as the implementation of safety management systems, regular maintenance of equipment, timely and thorough inspections, and the availability of skilled teams. Kusumasari et al., (2018) emphasize that effective project management, characterized by thorough planning and organization, is essential for overcoming challenges and ensuring successful implementation. Hidayati et al. (2021) argue that the presence of a skilled team is critical, as it directly impacts the adaptability and success of the software integration process. Mishra and Mahanty (2019) highlight that regular equipment maintenance is vital for maintaining operational efficiency and minimizing disruptions during software deployment. Furthermore, Elzamly and Hussin (2014) suggest that conducting clear and timely inspections is key to identifying potential issues early, thereby enhancing the reliability and quality of integrated software solutions.

3.7.2. Cluster 2 – Slow decision-making processes

The integration of software solutions is often hampered by slow decision-making, inadequate site supervision, and unrealistic project cost estimates. Althiyabi and Qureshi (2021) argue that slow decision-making hinders the resolution of integration issues, often arising from unclear project objectives and undefined scopes, which are crucial for effective project management. Zafar *et al.* (2011) further point out that inadequate site supervision exacerbates these challenges, leading to communication breakdowns and missed integration tasks, which contribute to project delays and cost overruns. According to Barbin and Rashidi (2015), unrealistic cost estimations, frequently resulting from poor budgeting practices, can lead to insufficient funding for critical resources and capabilities needed for successful software implementation. To address these issues, Khalid and Yeoh (2021) suggest that cost control frameworks like Earned Value Management (EVM) can provide a structured method for monitoring and adjusting project expenditures effectively.

3.7.3. Cluster 3 – Construction program document

Key factors such as the construction program document, architectural drawings, and work breakdown structure (WBS) are essential in

overcoming challenges associated with integrating software solutions. Supriyono and Chasanah, (2023) assert that the construction program document serves as a strategic roadmap, detailing timelines and resource allocations essential for effective project coordination and management. Architectural drawings provide a detailed visual representation of project requirements, promoting clarity and minimizing miscommunication among team members during implementation. While specific references may not address architectural drawings, their significance in ensuring alignment with project specifications is widely acknowledged. Islam and Rokonuzzaman (2011) identify the WBS as a key tool that breaks down the project into manageable tasks, enabling precise time and resource estimation for each phase. Furthermore

3.7.4. Cluster 4 – Low-skill workers

The integration of software solutions in construction faces significant barriers, including a workforce with limited skills, insufficient quality assurance processes, substandard construction materials, and inadequate technical expertise among contractors. Al-Emad, (2021) note that low-skill workers adversely affect productivity and project efficiency, often leading to delays and inconsistencies. Samarghandi *et al*. (2016) further argue that the lack of stringent quality assurance systems worsens these issues by permitting the use of substandard materials, thus undermining project standards. Additionally, Yaman *et al.* (2015) highlight that contractors without technical expertise face difficulties in effective project execution, resulting in resource mismanagement and failure to meet project requirements. To address these challenges, Mohammad et al. (2017) stressed the importance of targeted efforts to upskill the workforce, enforce strict quality control protocols, and enhance contractor training programs, ultimately improving project outcomes and facilitating better integration of technological solutions.

3.7.5. Cluster 5 – Failure to engage qualified professionals

The integration of software solutions in construction projects encounters notable obstacles, including the lack of engagement with qualified professionals, poor scheduling practices, contractor insolvency, and insufficient pre-construction planning.

3.7.6. Cluster 6 – Aesthetics of completed work

Aesthetic considerations, funding challenges, and client support significantly influence the integration of software solutions in construction projects. Choi and Lárusdóttir, (2023) underscore the critical role of design aesthetics in influencing user satisfaction and experience, which directly impacts the success of software implementation. Similarly, Honisett *et al.* (2022) emphasize the importance of adequate funding, noting that insufficient financial resources can lead to delays and compromise the quality of projects, a challenge observed across various industries, including healthcare and education. Furthermore, Wamuti *et al*. (2023) highlight that a lack of client support, particularly in terms of funding, exacerbates these challenges and increases the risk of project failure.

3.7.7. Cluster 7 – Structural failure during construction

Structural failures during the construction phase present significant challenges to the integration of software solutions in the construction industry. Czajkowska and Ingaldi (2021) point out that failures, typically stemming from insufficient safety protocols and oversight, lead to significant financial and human losses, underscoring the necessity for robust software systems to enable real-time monitoring and risk management. Similarly, Feng and Dai (2014) highlight that improper design and maintenance of temporary structures can result in catastrophic events, stressing the need for advanced software technologies that can ensure structural integrity through ongoing monitoring and analysis.

3.7.8. Cluster 8 – Communication and coordination between parties

Effective communication and coordination are essential for the successful integration of software solutions, particularly in distributed and collaborative environments. Vivian *et al*. (2018) emphasize that coordination breakdowns and poor communication among team members can lead to substantial delays and cost overruns, highlighting the importance of robust communication strategies to mitigate these issues. Additionally, Gargiulo and Sosa (2016) note that disruptions caused by common third parties in communication networks can impede team coordination, making the management of these relationships crucial for sustaining effective collaboration. In addition to communication, resource availability is a key determinant of successful software integration. The efficiency of development processes is closely tied to the adequacy of available resources.

3.8. The Strategies for Needs and Challenges of Software Solutions

The construction sector is increasingly leveraging software solutions to address industry challenges, focusing on integrating data analytics and enhancing employee well-being. A prominent strategy is the use of data analytics in marketing, which highlights the

value of data-driven approaches to improve marketing effectiveness. This aligns with research by Côrte-Real *et al*., (2019) who emphasize that analytical tools, such as dashboards and data mining, can significantly enhance business value. Similarly, Johnson *et al*. (2019) argues that transitioning to a data-driven organizational culture is essential for maximizing the potential of analytics, particularly as organizations vary in their experience with such technologies.

Employee well-being initiatives represent another critical strategy, reflecting the growing importance of integrating health and wellness into construction project management. Boorman (2010) underscores the positive influence of workforce health initiatives on employee satisfaction and productivity. Putra *et al*., (2023) further supports this, noting that organizations with diverse cultures and varying workforce needs are likely to prioritize these initiatives in different ways, highlighting the importance of adapting management strategies to address employee well-being. Efforts to mitigate work-related musculoskeletal disorders (WMSDs) further highlight the sector's focus on health. These initiatives address physical strains associated with construction work, fostering improved performance and employee satisfaction. Boorman (2010) advocates for the integration of wellness programs in organizational settings, highlighting their alignment with strategies that promote physical activity and overall workplace health to enhance workforce productivity. Technological adoption and innovation also play a key role in addressing construction challenges. Wang *et al*., (2016) highlight the potential of big data analytics to optimize logistics and supply chain management, which can extend to enhancing disaster resilience and management within the industry. These strategies underscore the need for technological advancements to streamline operations and improve project outcomes. While strategies related to sustainability and artificial intelligence are acknowledged within the sector, they appear to be less universally prioritized. Nevertheless, scholars like Pantano *et al*., (2020) argue that integrating sustainable practices and advanced AI technologies can deliver long-term organizational benefits, paving the way for a more sustainable and innovative construction industry. These strategies collectively represent a holistic approach to utilizing software solutions in construction. By balancing a focus on data analytics, employee well-being, and technological innovation, organizations can effectively tackle industry challenges, boost operational efficiency, and improve workforce satisfaction. This integrated approach provides valuable insights into shaping future initiatives aimed at advancing the construction sector.

4. Conclusion and Recommendations

This study was able to evaluate the strategies for the implementation of software solutions among construction professionals in Lagos State, Nigeria. In conclusion, the integration of software solutions in construction project management faces significant challenges, including insufficient funding, structural failures, and a lack of skilled teams. Addressing these issues through adequate funding, technical training, and quality assurance processes is essential for optimizing software adoption and improving project outcomes. Also, adopting software solutions in the construction sector, through strategies like data analytics, employee well-being initiatives, and technological innovation, offers significant potential to enhance operational efficiency and workforce satisfaction. Emphasizing these areas can address industry challenges, foster sustainability, and drive long-term improvements in project outcomes and organizational performance. Therefore, it is recommended that there is a need to prioritize structural integrity using advanced technologies like BIM, invest in workforce development to improve technical expertise and obtain sufficient funding for software acquisition and training to overcome obstacles in the adoption of software for construction project management. Smoother integration will also be supported by enhanced site monitoring and quality assurance procedures. It is also advised that construction companies take a comprehensive approach by embracing technological innovation, integrating data analytics, and giving employee well-being a priority. Tailored wellness programs and the use of big data for supply chain and logistics optimization will boost productivity, employee satisfaction, and long-term viability, propelling innovation and advancement in the sector.

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